

Fishery Data Series Number 96-3

Age, Weight and Length Statistics
of Togiak River Drainage Resident Fish Species,
Togiak National Wildlife Refuge, Alaska,
1993 - 1995

Mark J. Lisac

and

Rob MacDonald

May 1996

United States Department of the Interior
Fish and Wildlife Service
Togiak National Wildlife Refuge

Fisheries Data Series 96-3

May 1996

**Age, Weight and Length Statistics
of Togiak River Drainage Resident Fish Species,
Togiak National Wildlife Refuge, Alaska,
1993 - 1995**

Mark J. Lisac

Rob MacDonald

Keywords: Rainbow Trout, Arctic Grayling, Char, Northern Pike,
Togiak River, Pungokebuk Creek, Gechiak Creek,
Izavieknik River, Ongivinuck River, Kemuk River,
Southwest Alaska, Togiak National Wildlife Refuge

Togiak National Wildlife Refuge
U.S. Fish and Wildlife Service
P.O. Box 270
Dillingham, Alaska 99576
(907) 842-1063

The Fishery Data Series was established in 1994 to provide public access to unpublished study results. These reports are intended to document short-term field studies that are limited in or lacking statistical interpretation. Reports in this series receive limited internal review prior to release and may be finalized in more formal literature in the future. Consequently, these reports should not be cited without approval of the author or the Division of Fishery Resources.

The U.S. Department of Interior prohibits discrimination in Department Federally Conducted Programs on the basis of race, color, national origin, sex, age, or disability. If you believe that you have been discriminated against in any program, activity, or facility operated by the U.S. Fish and Wildlife Service or if you desire further information please write to:

U.S. Department of Interior
Office for Equal Opportunity
1849 C. Street, N.W.
Washington, D.C. 20240

TABLE OF CONTENTS

LIST OF TABLES	i
LIST OF FIGURES	ii
ABSTRACT	1
INTRODUCTION	2
STUDY AREA	5
METHODS	9
RESULTS	10
Pungokepuk Creek	10
Gechiak Creek	10
Ongivinuck River	11
Kemuk River	11
Izavieknik River	12
DISCUSSION	24
Rainbow trout	24
Arctic grayling	25
Char	25
Northern pike	25
RECOMMENDATIONS	26
ACKNOWLEDGMENTS	26
REFERENCES	27
APPENDICES	29

LIST OF TABLES

Table 1.	Sport fishing effort (angler days) and harvest (number of fish) of resident species from the Togiak River, 1977 - 1994.	4
Table 2.	Subsistence fishing effort (number of people) and harvest (number of fish) of resident species from the Togiak River, 1994	4
Table 3.	Mean lengths (mm) and weights (g) of rainbow trout by age group by year from Pungokepuk Creek, 1993 - 1995.	13
Table 4.	Mean lengths (mm) and weights (g) of Arctic grayling by age group by year from Pungokepuk Creek, 1993 - 1995.	14
Table 5.	Mean lengths (mm) and weights (g) of char by year from Pungokepuk Creek, 1993 and 1995	15
Table 6.	Mean lengths (mm) and weights (g) of northern pike by year from Pungokepuk Creek, 1993 and 1995	15
Table 7.	Mean lengths (mm) and weights (g) of rainbow trout by age group by year from Gechiak Creek, 1993 - 1995.	16
Table 8.	Mean lengths (mm) and weights (g) of Arctic grayling by age group by year from Gechiak Creek, 1994 - 1995	17
Table 9.	Mean lengths (mm) and weights (g) of char by year from Gechiak Creek, 1995	18
Table 10.	Mean lengths (mm) and weights (g) of rainbow trout by age group by year from the Ongivinuck River, 1995	18
Table 11.	Mean lengths (mm) and weights (g) of Arctic grayling by age group by year from the Ongivinuck River, 1994 - 1995.	19
Table 12.	Mean lengths (mm) and weights (g) of char from the Ongivinuck River, 1995. .	19
Table 13.	Mean lengths (mm) and weights (g) of rainbow trout by age group from the Kemuk River, 1995	20
Table 14.	Mean lengths (mm) and weights (g) of Arctic grayling by age group from the Kemuk River, 1995	20
Table 15.	Mean lengths (mm) and weights (g) of char from the Kemuk River, 1995.	20
Table 16.	Mean lengths (mm) and weights (g) of Arctic grayling by age group from the Izavieknik River, 1994	21
Appendix Table 1.	Sample size and data filename by year for the Togiak River drainage fishery samples collected and analyzed by USFWS, 1993 - 1995.	29
Appendix Table 2.	Distances traveled and hours taken for Togiak River drainage sampling trips	30
Appendix Table 3.	Number of rainbow trout caught, marked and recaptured and number of other species caught and sampled by survey trip per year, Pungokepuk Creek, 1993 to 1995.	31
Appendix Table 4.	Number of rainbow trout caught, marked and recaptured and number of other species caught and sampled by survey trip per year, Gechiak Creek, 1993 to 1995	32

Appendix Table 5.	Number of rainbow trout caught, marked and recaptured and number of other species caught and sampled by survey trip per year, Ongivinuck River, 1995.	33
Appendix Table 6.	Number of rainbow trout caught, marked and recaptured and number of other species caught and sampled by survey trip per year, Kemuk River, 1995	33
Appendix Table 7.	Number of rainbow trout caught, marked and recaptured and number of other species caught and sampled by survey trip per year, Izavieknik River, 1994	33

LIST OF FIGURES

Figure 1.	Togiak National Wildlife Refuge.	6
Figure 2.	Togiak River drainage and tributary study areas.	7
Figure 3.	Fork length frequency distribution (10 mm increments) for rainbow trout in Pungokepuk Creek, Togiak National Wildlife Refuge, 1993 - 1995.	22
Figure 4.	Fork length frequency distribution (10 mm increments) for rainbow trout in Gechiak Creek, Togiak National Wildlife Refuge, 1994 - 1995.	23

**Age, Weight and Length Statistics of Togiak River Drainage Resident Fish Species,
Togiak National Wildlife Refuge, Alaska, 1993 - 1995.**

ABSTRACT - This reports summarizes baseline fisheries data collected from Togiak River tributaries within Togiak National Wildlife Refuge in southwest Alaska from 1993 to 1995. Pungokepuk and Gechiak Creeks, and the Ongivinuck, Kemuk and Izavieknik Rivers were included in this survey. Length and weight were measured from all fish captured and scale samples for aging were collected from captured rainbow trout and Arctic grayling. In addition rainbow trout were marked with a numbered tag. All fish were released.

From Pungokepuk Creek, 471 rainbow trout, 107 Arctic grayling, 42 char and 44 northern pike were captured. From Gechiak Creek, 449 rainbow trout, 11 Arctic grayling and 36 char were captured. From the Ongivinuck River, 5 rainbow trout, 42 Arctic grayling and 22 char were captured. From the Kemuk River, 5 rainbow trout, 1 Arctic grayling and 16 char were captured. From the Izavieknik River, 1 Arctic grayling was captured. In addition, 498 char were caught in the Izavieknik River in 1994 but no measurements were taken.

Rainbow trout ages ranged from 1 to 12 years, fork lengths ranged from 143 mm to 750 mm and weights ranged from 25 g to 4200 g. Arctic grayling ages ranged from 1 to 9 years, fork lengths ranged from 157 mm to 650 mm and weights ranged from 50 g to 1400 g. Ages were not determined for the char samples. Char fork lengths ranged from 258 mm to 576 mm and weights ranged from 200 g to 1900 g. Ages were not determined for the northern pike samples collected. Northern pike fork lengths ranged from 298 mm to 680 mm and weights ranged from 375 g to 2200 g.

Of the 930 rainbow trout caught and sampled in the Togiak River drainage, 741 were marked with floy tags and 52 were recaptures. A noteworthy recaptured fish in 1995 traveled 39.45 km in 58 days from Pungokepuk Creek to the Kemuk River. All other recaptured fish were found in the tributary of initial capture.

We recommend that long term monitoring be continued and the study area be expanded to include other tributary systems, tributary lakes and the main Togiak River. Specific recommendations include: (1) continued sampling throughout the drainage to replicate age, weight, and length frequencies for resident species; (2) measuring and sampling all recaptured fish for age; (3) secondary marking of tagged fish to allow an estimate of tag loss; (4) marking all grayling and char captured; (5) measuring total length and fork length of fish, especially rainbow trout, to aid in the assessment of relative stock density categories; (6) use radio telemetry to determine if rainbow trout in the tributaries are discrete populations; and (7) measuring all char captured and sacrifice a sample to determine species, age and maturity.

INTRODUCTION

Freshwater fishes are important sport and subsistence fishery resources within the Togiak National Wildlife Refuge (Refuge) in southwest Alaska. Rainbow trout *Oncorhynchus mykiss*, Arctic grayling *Thymallus Arcticus*, char *Salvelinus species*, northern pike *Esox lucius*, and the five species of Pacific salmon *Onchorhynchus species* are found throughout the Refuge. One of the primary purposes of the Refuge is to conserve fish and wildlife in their natural diversity. The Fisheries Management Plan (FMP) for the Refuge (USFWS 1990) documented species distribution throughout the Refuge and identified baseline population data gaps for resident species and anadromous char. Many waters are known to support resident fish populations, but baseline biological data are lacking.

Refuge personnel collected baseline age, weight and length (AWL) data from rainbow trout, Arctic grayling, char and northern pike in the Togiak River drainage from 1993 to 1995. Rainbow trout were the primary target with the other species being sampled opportunistically. The main focus of sampling in the Togiak River drainage has been on Pungokepuk and Gechiak Creeks and the Ongivinuck, Kemuk and Izavieknik Rivers.

The effort and harvest from the sport fishery on the Togiak River has been documented since 1977 (Minard and Dunaway 1995, and Howe, Fidler and Mills 1995). Over that time, the sportfishing effort has generally increased from 675 angler days in 1977 to 2,361 angler days in 1994 and averaged 1,407 angler days (Table 1). Of the species other than salmon anglers caught Dolly Varden/Arctic char most often, followed by rainbow trout, Arctic grayling and then northern pike. There are no special sport fishing methods, means and harvest limits specified for the Togiak drainage. For the last 10 years the state sportfishing regulations have been standard throughout the drainage and allow for a bag limit of 10 fish per day with 10 in possession and no size restrictions for char, and 5 grayling per day with 5 in possession with no size restrictions throughout the year. For rainbow trout, the bag limit is 2 per day and 2 in possession from 8 June - 31 October, and 5 per day and 5 in possession from 1 November - 7 June. Harvest of only one rainbow trout over 20 inches (500 mm) is allowed as part of the daily and possession limits during both time frames. There are no size or possession limits on northern pike.

The effort and harvest from the subsistence fishery on the Togiak River was documented in 1994 (ADFG 1995, in prep). This survey estimated use of the Togiak drainage by the villages of Togiak and Manokotak. Throughout the whole Togiak drainage, 528 people taking multiple trips attempted to harvest freshwater fish in 1994 (Table 2). Dolly Varden/Arctic char accounted for the most fish harvested (10,462), followed by northern pike (1,157), rainbow trout (897) and grayling (124). Most of the subsistence harvested char, northern pike and rainbow trout were captured in the lower Togiak River. Most of the grayling taken for subsistence were from the Togiak Lakes.

The objectives of this report are to:

1. Document the age, weight, length and distribution of rainbow trout and Arctic grayling

captured in the Togiak River drainage.

2. Document the weight and length composition, and distribution of northern pike and char (spp?) captured in the Togiak River drainage.
3. Compile age, weight and length data on an annual basis and make available to resource managers in a standard format archived in the State Research and Technical Service (RTS) system.

Table 1. Sport fishing effort (angler days) and harvest (number of fish) of resident species from the Togiak River, 1977 - 1994. a

Species	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994 b	Average 1977-1994
Effort	675	539	1,666	1,513	932	1,160	972	3,497	1,290	1,208	848	1,055	1,174	1,638	1,729	1,419	1,647	2,361	1407
Rainbow trout	102	54	82	215	130	168	336	32	0	58	46	91	437	22	14	0	0	8	100
Arctic grayling	26	18	200	241	43	31	315	150	0	0	46	109	62	0	0	23	65	20	75
Dolly Varden/ Arctic char	133	72	236	560	345	671	1,007	758	178	1,133	547	146	218	88	78	66	117	137	361
Northern pike	12	0	0	0	0	84	0	25	0	29	0	18	0	44	0	9	17	0	13

a Information from Minard and Dunaway 1995. The 1994 Area Management Report for the recreational fisheries of the southwest Alaska Sport Fish Management Area. Division of Sport Fish.

b Information from Howe, Fidler and Mills 1995. Harvest, catch, and participation in Alaska sport fisheries during 1994. Division of Sport Fish.

Table 2. Subsistence fishing effort (number of people) and harvest (number of fish) of resident species from the Togiak River, 1994. a

	Effort	Rainbow trout	Arctic grayling	Dolly Varden/ Arctic char	Northern pike
Lower Togiak River		420	0	6,827	620
Middle Togiak River		140	13	1,059	324
Upper Togiak River		0	0	792	92
Togiak Lakes		337	111	1,558	0
Gechiak		0	0	226	105
Pungokepuk		0	0	0	16
Total Togiak River	528	897	124	10,462	1,157

a Information from ADFG 1995, in prep. The Harvest and Use of Freshwater Fish in Togiak and Manokotak, 1994-95. Division of Subsistence.

STUDY AREA

The Togiak River drainage is within the 4.7 million acre Togiak National Wildlife Refuge in southwest Alaska (Figure 1), and encompasses 5,178 km² (2,000 mi²) (Figure 2). The Togiak River is 100.1 km (63 mi) from the outlet of Togiak Lake to Togiak Bay. Seven major tributaries include the following: Gechiak, Pungokepuk, and Trail Creeks, and the Naylorun (Kashaiak), Kemuk, Ongivinuck and Izavieknik Rivers. Several smaller, un-named tributaries also enter the river. The Togiak River drainage has the following nine major lakes: Togiak, Nagugun, Nenevok, High, Upper Togiak, West Togiak, Gechiak, Pungokepuk and Ongivinuck Lakes. The Izavieknik River flows through Upper Togiak Lake and into Togiak Lake. Additional descriptions and previous survey information on the tributaries and lakes of the Togiak valley are available in the Togiak Refuge Fisheries Management Plan (USFWS 1990).

Pungokepuk Creek flows in a southwest direction 25.4 km from Pungokepuk Lake (604 ha) to the Togiak River (USFWS 1990). One of two main tributaries flowing into Pungokepuk Creek is an unnamed tributary 2.1 km downstream from the lake. Nicholls Creek is the other and enters Pungokepuk Creek 9.1 km downstream from Pungokepuk Lake. There is a short section of rapids located 9.8 km downstream from Pungokepuk Lake where the creek flows through a narrow, rocky gorge with an accompanying drop in altitude. Pungokepuk Creek drains into the east side of the Togiak River 29.8 km upstream from Togiak Bay.

Fish species known to be present in the Pungokepuk drainage are king, coho, sockeye, chum and pink salmon, rainbow trout, Arctic grayling, char and northern pike. Access to Pungokepuk Creek is primarily by rafting from Pungokepuk Lake downstream to the Togiak River. Guided motorboat operators fish the confluence of Pungokepuk Creek and the Togiak River, however, the creek itself is too shallow and rocky to boat upstream. The creek is also easily accessible on foot in the upper and lower reaches.

Gechiak Creek flows in a southeast direction 28.3 km from Gechiak Lake (438 ha) to the Togiak River (USFWS 1990). Five measurements along the creek's length show an average width of 20.6 m, an average depth of 0.73 m, and an average stream flow of 0.98 m/sec. Numerous small, unnamed tributaries flow into Gechiak Creek throughout its course. Gechiak Creek is a narrow, meandering creek with overhanging brush and downed trees. There are two portages through dense alders and willows where the river becomes braided into many channels. The portages are located 3.8 km and 7.1 km downstream from Gechiak Lake. In many other places, brush and trees have to be pushed out of the way to be able to continue downstream. Gechiak Creek drains into the west side of the Togiak River 21.1 km upstream from Togiak Bay.

Fish species known to be present in the Gechiak drainage are king, coho, sockeye, chum and pink salmon, rainbow trout, Arctic grayling, and char. Access to Gechiak Creek is primarily by motorboat. Guided motorboat operators fish the lower sections of the creek boating upstream about 7.6 km from the Togiak River and by wading the upper 3 km. The confluence of Gechiak

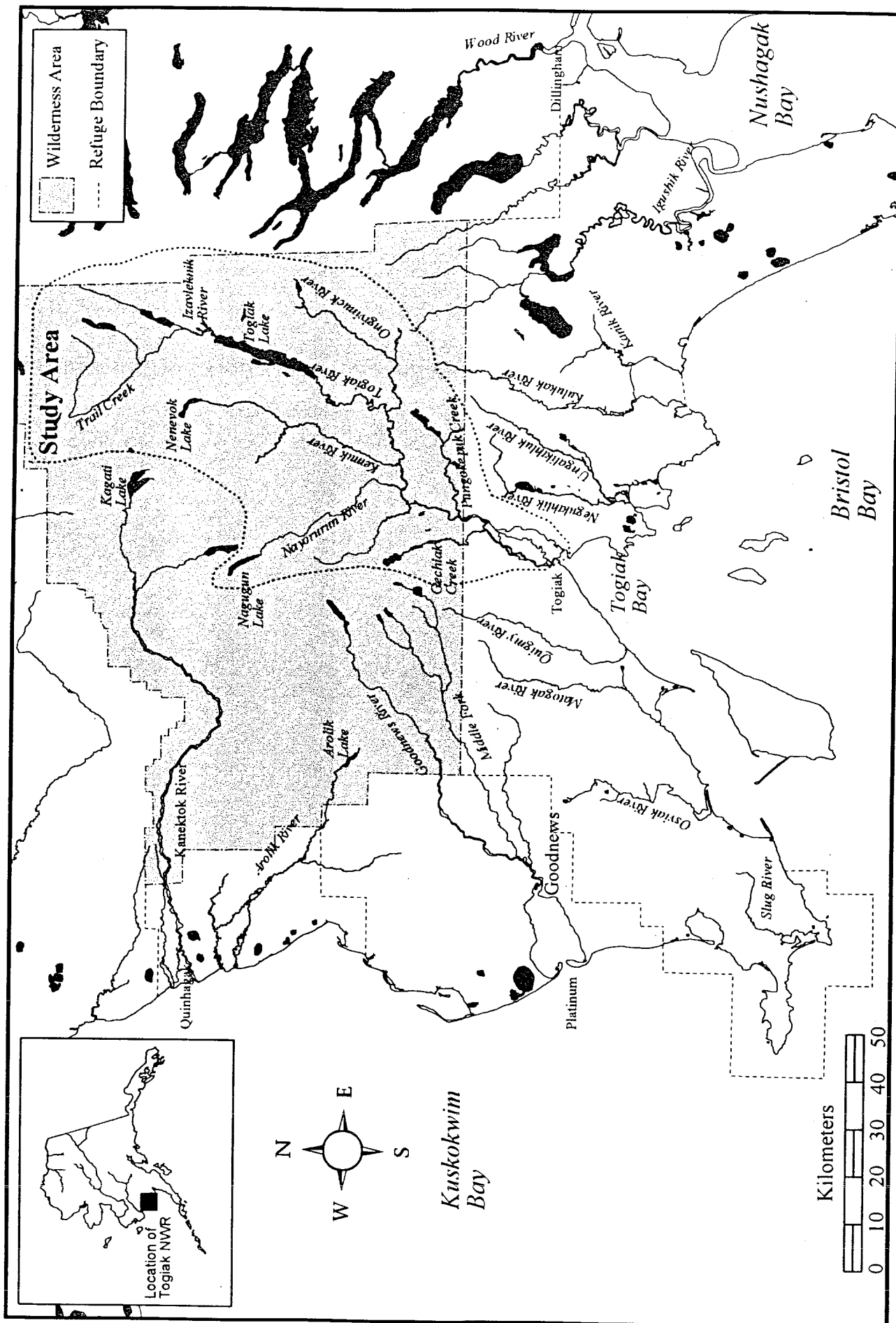


Figure 1. Togiak National Wildlife Refuge.

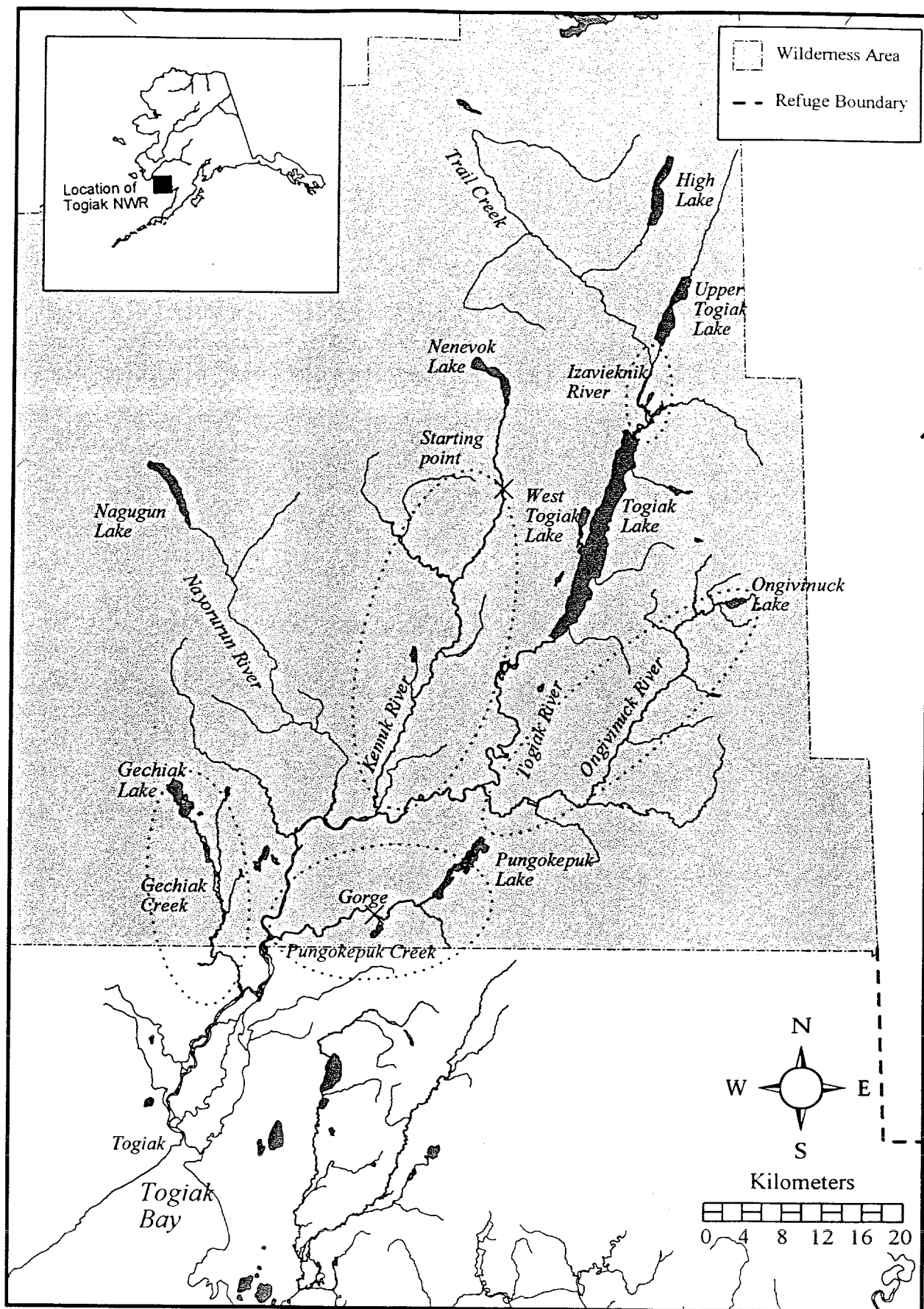


Figure 2. Togiak River drainage and tributary study areas.

Creek and the Togiak River is fished for the five species of salmon. The creek can be floated and portaged with a small raft and is accessible by float plane dropoff at Gechiak Lake.

The Ongivinuck River flows in a southwest direction 50.5 km from Ongivinuck Lake (79 ha) to the Togiak River (USFWS 1990). The outlet of Ongivinuck Lake is 17.1 m wide and is probably below average for the river's length. At the lake outlet, the water flows at 3.3 m/sec. No Lake Creek, 33.6 km downstream from Ongivinuck Lake, is the main tributary into the Ongivinuck River. In addition, numerous small to medium sized, unnamed tributaries flow into the Ongivinuck River throughout its course. The Ongivinuck River drains into the east side of the Togiak River 70.0 km upstream from Togiak Bay.

Fish species known to be present in the Ongivinuck drainage are king, coho, sockeye, chum and pink salmon, rainbow trout, Arctic grayling, and char. Access to the Ongivinuck River is primarily by motorboat. Guided motorboat operators fish the lower sections of the river boating up from the Togiak River. There are several private cabins on the river approximately 39.9 km downstream from the lake. The confluence of the Ongivinuck River with the Togiak River is fished for char and the five species of salmon. The creek is floatable with a raft and is accessible by float plane dropoff at Ongivinuck Lake.

The Kemuk River flows in a southern direction 46.6 km from Nenevok Lake (246 ha) to the Togiak River (USFWS 1990). One main tributary stream drains from the mountains to the west and enters the Kemuk River 18.7 km downstream from Nenevok Lake. In addition, numerous small to medium sized, unnamed tributaries flow into the Kemuk River throughout the course of the river. The Kemuk River drains into the west side of the Togiak River 53.2 km upstream from Togiak Bay.

Fish species known to be present in the Kemuk drainage are king, coho, sockeye and chum salmon, rainbow trout, Arctic grayling, and char. Access to the Kemuk River is primarily by motorboat. Guided motorboat operators fish the lower sections of the river boating up from the Togiak River. The river is too shallow and rocky to allow a float trip from Nenevok Lake.

The Izavieknik River begins in the Wood River Mountains with no headwater lake and flows in a southeast direction for 12.1 km before draining into Upper Togiak Lake (738 ha). From Upper Togiak Lake, the Izavieknik River flows 11.8 km to Togiak Lake (USFWS 1990). The outlet of Upper Togiak Lake is 45.8 m (150 feet wide). Trail Creek is the first of two tributaries and joins the Izavieknik on the west side 1.9 km downstream from Upper Togiak Lake. The second tributary is unnamed and flows in from the east side 7.0 km downstream from Upper Togiak Lake. In addition, numerous small, unnamed tributaries flow into the Izavieknik River throughout the course of the river.

Fish species known to be present in the Izavieknik drainage are king, coho, sockeye, chum and pink salmon, Arctic grayling, and char. Rainbow trout are reported to be present by sport fish guides who have operated in the area. Access to the Izavieknik River is primarily by motorboat

or airplane. Motorboat access is primarily by people from the village of Togiak. The river is floatable from Upper Togiak Lake to Togiak Lake.

METHODS

Rainbow trout, Arctic grayling, char and northern pike were caught using hook and line. Once captured the fish were measured using standard age, weight and length (AWL) sampling as outlined in Clutter and Whitesel (1956). Scales from rainbow trout and Arctic grayling were collected from the left side of the fish in the preferred area (Jearld 1983). No scales were taken from char or pike. Fork length was measured to the nearest millimeter (mm), and weight was recorded to the nearest 25 grams (g). Rainbow trout having a length of 200 mm or greater were marked with individually numbered Floy™ spaghetti tags. Recaptured rainbow trout were measured for length and weight and scale samples were collected from the right side of the fish to avoid regenerated scales from the previously collected area. Length, weight, tag number, date, time of capture, location, collector, and any distinguishing characteristics (recapture, mortality, condition, etc.) were recorded on individual scale envelopes.

Captured char *Salvelinus species* were not sacrificed to determine whether they were Dolly Varden or Arctic char and are reported here together as char. Ages were not determined from char or northern pike samples collected.

Data were transferred to Alaska Department of Fish and Game (ADFG) Standard Age Weight Length Form (V1.1) mark-sense data form (ADFG 1990). Data forms are sent to ADFG Research and Technical Services (RTS) for op-scanning. Each data set is assigned a file number which corresponds to the State fisheries management area, the species sampled, and the year of collection (Heineman 1989a) (Appendix Table 1).

Acetate impressions were made of scales using a hydraulic press (Dery 1983 and Riffe 1994). All scales were aged using a Canon PC 70M microfiche copier with a forty-power (40x) lens via methods outlined in Mosher (1969), Lux (undated) and Coggins (1994). The total age in years is recorded. The scale reader makes three independent age determinations for each scale sample. The mean modal age is then reported as suggested by Coggins (1994). Samples with no modal age are treated as unreadable and included with regenerated scales as age unknown samples throughout the presented tables.

Completed data sets were then analyzed using a crosstabulation program called BBX2, developed by ADFG Research and Technical Services (Heineman 1989b). The BBX2 program produces unweighted estimates of mean length and percentage by age group and the associated standard error estimates following procedures outlined by Sokal and Rohlf (1981, Boxes 4.2 and 7.1, pages 56 and 139) (Riffe 1994). Summary tables produced by the BBX2 program are presented here as Tables 3-16.

Distances, in kilometers (km), between land marks and lengths of surveyed waterways were determined by using Atlas™ G.I.S., a computer information mapping software. USGS quadrangle maps (1:63,360 scale) were digitized for use by the software. Locations of individually marked rainbow trout were determined using a handheld global positioning system (GPS) unit. The latitude and longitude coordinates were entered into common spreadsheet software and read by the G.I.S. software for plotting and analysis.

RESULTS

Pungokepuk Creek

Pungokepuk Creek was sampled from the outlet of Pungokepuk Lake downstream to the confluence with the Togiak River (Appendix Tables 2 and 3). Three float trips were conducted in each year from 1993 to 1995. The first night of each trip was spent at the lake outlet. Approximately 7 hours of sampling occurs in the upper 1.6 km of Pungokepuk Creek and lake outlet. On the second day, 10 hours of sampling takes us about 9.1 km to Nicholls Creek. Twelve hours of sampling during the third day takes us about 8.2 km further downstream. On this day we travel through the "gorge," a short rapids created by a narrowing of the creek with a drop in altitude. Large boulders create various degrees of white water depending on the water level at the time. The last day of sampling takes us 8.1 km to the Togiak River in approximately 4 hours.

In 1993, scale samples, weights and lengths were collected in Pungokepuk Creek from 132 rainbow trout, 33 grayling, 1 char and 5 northern pike (Appendix Table 3). In 1994, scale samples, weights and lengths were collected from 109 rainbow trout and 18 grayling. In 1995, scale samples, weights and lengths were collected from 230 rainbow trout, 56 grayling, 41 char and 39 northern pike. Only lengths and weights were taken from the char and pike samples that were collected. Data and analysis are presented by species by year in Tables 3 through 6 and Figure 3.

There were 113 rainbow trout marked and released in 1993, 91 in 1994, and 182 in 1995 for a total of 386 tagged fish at large (Appendix Table 3). There were 42 recaptured fish from 1993 to 1995. All recaptured fish were Pungokepuk Creek rainbow trout.

Gechiak Creek

In 1993, only the upper 1.4 km below the lake outlet was sampled. In 1994 and 1995, Gechiak Creek was sampled from the outlet of Gechiak Lake downstream to the confluence with the Togiak River (Appendix Tables 2 and 4). Sampling on the first day occurs for about 11 hours from the lake downstream 2.3 km. The second day covers 3.7 km in 12 hours. For the third day, 13.7 km are covered in 12 hours. On the final day, 3 hours takes us the remaining 8.6 km to the Togiak River.

In 1993, scale samples, weights and lengths were collected from 9 rainbow trout. In 1994, scale samples, weights and lengths were collected from 177 rainbow trout and 5 grayling. In 1995, scale samples, weights and lengths were collected from 263 rainbow trout, 6 grayling and 36 char (Appendix Table 4). No scales were collected from the char that were captured. Data and analysis are presented by species by year in Tables 7 through 9 and Figure 4.

There were 7 rainbow trout marked and released in 1993, 139 in 1994, and 200 in 1995 (Appendix Table 4) for a total of 346 tagged fish at large. There were a total of 9 recaptured fish from 1993 to 1995. All recaptured fish were Gechiak Creek rainbow trout.

Ongivinuck River

The Ongivinuck River was sampled by float trip from Ongivinuck Lake to the confluence with the Togiak River in 1995 (Appendix Tables 2 and 5). During the first day, 5.4 km were traveled in 3 hours of floating. On the second day, 23.7 km were traveled in 12 hours. On the third day, the final 21.4 km were traveled in 10 hours.

In 1994, the University of Alaska Bristol Bay Campus Marine Advisory Program class floated the river and sampled 3 Arctic grayling which are included in this report. In 1995, the Refuge Fisheries staff floated the river to sample the resident species.

Scale samples, weights, and lengths were collected from 3 grayling in the Ongivinuck River in 1994 and from 5 rainbow trout, 39 grayling and 22 char in the Ongivinuck River in 1995 (Appendix Table 5). No scales were taken from captured char. Data and analysis are presented by species in Tables 10 through 12.

Five (5) rainbow trout were tagged in 1995 (Appendix Table 5). This was the first year rainbow trout were tagged on the Ongivinuck River and no fish tagged this year were recaptured.

Kemuk River

The lower 34.5 km of the Kemuk River was sampled by float trip in 1995 (Appendix Tables 2 and 6). The primary purpose of this trip was a raptor nest survey with fish being capture incidentally. A helicopter was used to place the field crew on the river 12.1 km downstream from Nenevok Lake since the Kemuk River did not appear safely navigable above this point. During the first day, the field crew traveled 5.0 km. During the second day, the crew traveled 11.6 km to the confluence with the west tributary stream where the first resident species was caught. Most of this second day was spent away from the river searching for raptor nests. On the third day, 17.9 km were traveled as the field crew reached the Togiak River.

Scale samples, weights, and lengths were collected from 5 rainbow trout and 1 grayling in the Kemuk River in 1995. Lengths and weights were measured for 16 char captured. Data and analysis are presented by species in Tables 13 through 15.

There were 4 rainbow trout marked in 1995 (Appendix Table 6). One fish was recaptured 10.8 km upstream from the Togiak River on 14 July 1995. This rainbow trout was captured and marked on 17 May 1995 in Pungokepuk Creek, 4.7 km upstream from the Togiak River. In the 58 day period, this fish traveled 39.45 km from Pungokepuk Creek to the Kemuk River.

Izavieknik River

The Izavieknik River was sampled from the outlet of Upper Togiak Lake to Togiak Lake in 1994 during a 6-day float trip (Appendix Tables 2 and 7). The river was easily waded for 1.9 km to Trail Creek in 6 hours. Trail Creek adds a significant amount of water to the Izavieknik River. The increased water depth and densely vegetated banks made wading difficult. From Trail Creek to an unnamed tributary 7.0 km downstream, flowing in on the east side of the river, the Izavieknik River was waded and floated in 8 hours. The 2.9 km distance from the unnamed tributary to Togiak Lake was floated in 0.5 hours.

One grayling was sampled on the Izavieknik River in 1994 (Table 16). No rainbow trout were captured during this survey. There were 498 char caught on the Izavieknik River in 1994 but none of these fish were sampled.

Table 3. Mean lengths (mm) and weights (g) of rainbow trout by age group by year from Pungokepuk Creek, 1993 - 1995.

	Age Group												
	UNKNOWN	1	2	3	4	5	6	7	8	9	10	11	TOTAL
1993													
n (number)	21		1	1	16	29	31	25	7	1			132
Percent			0.9	0.9	14.4	26.1	27.9	22.5	6.3	0.9			100.0
Std. Error			0.90	0.90	3.35	4.19	4.28	3.98	2.32	0.90			
Mean Length	519		167	320	375	446	476	555	563	695			481
Std. Error	17.43				14.41	12.78	10.14	16.45	28.29				8.36
Sample Size	21		1	1	16	29	31	25	7	1			132
Mean Weight	1489			500	695	1056	1277	1933	1936	3600			1357
Std. Error	194.93				71.97	88.55	106.29	152.33	281.73				67.45
Sample Size	25			1	15	29	30	24	7	1			132
1994													
n (number)	18		1	9	11	5	23	25	11	3	1	2	109
Percent			1.1	9.9	12.1	5.5	25.3	27.5	12.1	3.3	1.1	2.2	100.0
Std. Error			1.10	3.15	3.44	2.40	4.58	4.71	3.44	1.88	1.10	1.55	
Mean Length	519		200	323	341	448	451	486	543	667	650	587	465
Std. Error	20.71			10.04	7.41	5.35	13.24	13.06	24.00	13.68		57.50	9.91
Sample Size	18		1	9	11	5	23	25	11	3	1	2	109
Mean Weight	1796			450	553	1035	1251	1356	1986	3500	2850	2425	1399
Std. Error	235.54			36.60	52.47	52.20	132.86	130.39	298.09	152.75		625.00	88.11
Sample Size	21			8	11	5	22	25	11	3	1	2	109
1995													
n (number)	35	4	6	44	46	24	32	25	10	4			230
Percent		2.1	3.1	22.6	23.6	12.3	16.4	12.8	5.1	2.1			100.0
Std. Error		1.02	1.24	3.00	3.05	2.36	2.66	2.40	1.58	1.02			
Mean Length	499	171	266	330	401	458	500	550	565	620			441
Std. Error	13.85	11.35	7.67	8.09	6.11	6.97	9.15	15.22	24.55	27.83			7.15
Sample Size	36	4	6	44	46	24	31	25	10	4			230
Mean Weight	1524	69	271	506	806	1173	1540	1862	1962	2456			1159
Std. Error	100.26	18.75	22.75	36.78	37.00	63.43	90.08	129.41	205.35	213.20			46.05
Sample Size	36	4	6	44	46	24	31	25	10	4			230

Table 4. Mean lengths (mm) and weights (g) of Arctic grayling by age group by year from Pungokepuk Creek, 1993 - 1995.

		Age Group										
		UNKNOWN	1	2	3	4	5	6	7	8	9	TOTAL
1993												
n (number)						5	2	13	7	5	1	33
Percent						15.2	6.1	39.4	21.2	15.2	3	100.0
Std. Error						6.34	4.22	8.64	7.23	6.34	3.03	
Mean Length						344	414	419	434	459	475	418
Std. Error						7.37	6.00	3.78	6.47	7.19		6.64
Sample Size						5	2	13	7	5	1	33
Mean Weight						450	1000	871	1029	910	1200	877
Std. Error						64.55	100.00	42.84	74.69	155.24		47.06
Sample Size	2					4	2	12	7	5	1	33
1994												
n (number)	1			1	4	1	5	4	2			18
Percent				5.9	23.5	5.9	29.4	23.5	11.8			100.0
Std. Error				5.88	10.60	5.88	11.39	10.60	8.05			
Mean Length	478			348	370	430	419	451	439			417
Std. Error					10.52		11.99	5.68	4.50			9.52
Sample Size	1			1	4	1	5	4	2			18
Mean Weight	1300			500	500	1100	875	1100	1075			892
Std. Error					66.14		75.00	104.08	75.00			85.32
Sample Size	6			1	3	1	2	3	2			18
1995												
n (number)	1	1	3	3	1	14	14	13	6			56
Percent		1.8	5.5	5.5	1.8	25.5	25.5	23.6	10.9			100.0
Std. Error		1.82	3.09	3.09	1.82	5.93	5.93	5.78	4.24			
Mean Length	408	172	235	307	352	393	417	429	443			395
Std. Error			5.24	7.77		3.33	5.79	7.45	12.10			8.25
Sample Size	1	1	3	3	1	14	14	13	6			56
Mean Weight	900	100	183	442	650	749	919	944	939			798
Std. Error			16.67	87.00		22.44	33.63	42.19	75.28			33.93
Sample Size	2	1	3	3	1	14	13	13	6			56

Table 5. Mean lengths (mm) and weights (g) of char by year from Pungokepuk Creek, 1993 and 1995.

	TOTAL
1993	
Mean Length	470
Std. Error	
Sample Size	1
Mean Weight	1100
Std. Error	
Sample Size	1
1995	
Mean Length	477
Std. Error	7.67
Sample Size	41
Mean Weight	1111
Std. Error	46.41
Sample Size	41

Table 6. Mean lengths (mm) and weights (g) of northern pike by year from Pungokepuk Creek, 1993 and 1995.

	TOTAL
1993	
Mean Length	542
Std. Error	9.95
Sample Size	5
Mean Weight	1020
Std. Error	86.02
Sample Size	5
1995	
Mean Length	499
Std. Error	13.99
Sample Size	39
Mean Weight	985
Std. Error	65.33
Sample Size	39

Table 7. Mean lengths (mm) and weights (g) of rainbow trout by age group by year from Gechiak Creek, 1993 - 1995.

	Age Group												
	UNKNOWN	2	3	4	5	6	7	8	9	10	11	12	TOTAL
1993													
n (Known Age)					1	2	1		1				5
Percent					20.0	40.0	20.0		20.0				100.0
Std. Err.					20.00	24.49	20.00		20.00				
Mean Length	527				368	398	395		508				464
Std. Err.	40.92					16.50							29.11
Sample Size	4				1	2	1		1				9
Mean Weight	1644				700	625	800		1850				1242
Std. Err.	385.19					75.00							237.39
Sample Size	4				1	2	1		1				9
1994													
n (Known Age)		4	12	14	24	30	32	32	16	4		1	169
Percent		2.4	7.1	8.3	14.2	17.8	18.9	18.9	9.5	2.4		0.6	100.0
Std. Err.		1.17	1.98	2.13	2.69	2.95	3.02	3.02	2.26	1.17		0.59	
Mean Length	383	285	306	323	343	370	394	435	461	474		454	384
Std. Err.	32.11	21.84	11.55	10.99	8.58	6.50	7.31	7.69	13.73	22.95			4.98
Sample Size	8	4	12	14	24	30	32	31	16	4		1	176
Mean Weight	734	438	469	529	593	731	842	1075	1281	1369		1150	823
Std. Err.	124.01	129.70	50.86	52.41	41.98	55.23	59.28	61.20	101.54	237.47			30.01
Sample Size	8	4	12	13	23	29	31	31	16	4		1	172
1995													
n (Known Age)		14	94	34	39	33	11	3					228
Percent		6.1	41.2	14.9	17.1	14.5	4.8	1.3					100.0
Std. Err.		1.59	3.27	2.36	2.50	2.34	1.42	0.76					
Mean Length	422	261	299	364	403	442	503	497					366
Std. Err.	12.41	5.70	3.48	7.96	5.70	6.16	10.31	40.63					4.91
Sample Size	35	14	94	34	39	33	11	3					263
Mean Weight	925	261	344	567	756	955	1382	1408					639
Std. Err.	66.06	13.29	11.64	37.70	36.76	45.72	74.02	365.53					23.65
Sample Size	35	14	94	34	39	33	11	3					263

Table 8. Mean lengths (mm) and weights (g) of Arctic grayling by age group by year from Gechiak Creek, 1994 - 1995.

	Age Group							
	2	3	4	5	6	7	8	TOTAL
	1994							
n (number)	1			1		2	1	5
Percent	20.0			20.0		40.0	20.0	100.0
Std. Err.	20.00			20.00		24.49	20.00	
Mean Length	223			650		456	450	447
Std. Err.						14.50		67.82
Sample Size	1			1		2	1	5
Mean Weight	150			1365		1100	1250	993
Std. Err.						0.00		216.56
Sample Size	1			1		2	1	5
	1995							
n (number)		1			1	1	3	6
Percent		16.7			16.7	16.7	50.0	100.0
Std. Err.		16.67			16.67	16.67	22.36	
Mean Length		318			387	467	455	423
Std. Err.							4.51	24.12
Sample Size		1			1	1	3	6
Mean Weight		375			725	1000	1217	958
Std. Err.							30.05	141.67
Sample Size		1			1	1	3	6

Table 9. Mean lengths (mm) and weights (g) of char by year from Gechiak Creek, 1995.

	Age Group	
	UNKNOWN	TOTAL
1995		
n (Known Age)		
Percent		
Std. Err.		
Mean Length	466	466
Std. Err.	9.73	9.73
Sample Size	36	36
Mean Weight	1089	1089
Std. Err.	56.37	56.37
Sample Size	36	36

Table 10. Mean lengths (mm) and weights (g) of rainbow trout by age group by year from the Ongivinuck River, 1995.

	Age Group			
	6	7	8	TOTAL
1995				
n (Known Age)	2	2	1	5
Percent	40.0	40.0	20.0	100.0
Std. Err.	24.49	24.49	20.00	
Mean Length	446	505	567	494
Std. Err.	35.00	4.50		25.19
Sample Size	2	2	1	5
Mean Weight	1087	1475	1875	1400
Std. Err.	237.50	75.00		166.77
Sample Size	2	2	1	5

Table 11. Mean lengths (mm) and weights (g) of Arctic grayling by age group by year from the Ongivinuck River, 1994 - 1995.

	Age Group									
	UNKNOWN	2	3	4	5	6	7	8	9	TOTAL
1994										
n (number)	1					1	1			3
Percent						50.0	50.0			100.0
Std. Err.						50.00	50.00			
Mean Length	485					405	460			450
Std. Err.										23.63
Sample Size	1					1	1			3
Mean Weight							1350			1350
Std. Err.										
Sample Size	2						1			3
1995										
n (number)		4	5	3	5	3	2	14	3	39
Percent		10.3	12.8	7.7	12.8	7.7	5.1	35.9	7.7	100.0
Std. Err.		4.92	5.42	4.32	5.42	4.32	3.58	7.78	4.32	
Mean Length		186	251	311	393	423	427	442	454	374
Std. Err.		10.90	9.05	9.29	17.62	6.57	0.50	4.90	18.21	15.24
Sample Size		4	5	3	5	3	2	14	3	39
Mean Weight		75	215	425	815	967	1212	1139	1342	821
Std. Err.		10.21	35.00	52.04	64.03	65.09	12.50	36.85	58.33	71.38
Sample Size		4	5	3	5	3	2	14	3	39

Table 12. Mean lengths (mm) and weights (g) of char by year from the Ongivinuck River, 1995.

	TOTAL
1995	
Mean Length	415
Std. Err.	12.38
Sample Size	22
Mean Weight	802
Std. Err.	67.72
Sample Size	22

Table 13. Mean lengths (mm) and weights (g) of rainbow trout by age group from the Kemuk River, 1995.

		Age Group				
		UNKNOWN	6	7	8	TOTAL
	<u>1995</u>					
n (number)		1	2	1	1	5
Percent			50.0	25.0	25.0	100.0
Std. Err.			28.87	25.00	25.00	
Mean Length		428	560	530	537	523
Std. Err.			49.50			29.14
Sample Size		1	2	1	1	5
Mean Weight			1875	1600	1400	1688
Std. Err.			425.00			208.54
Sample Size		1	2	1	1	5

Table 14. Mean lengths (mm) and weights (g) of Arctic grayling by age group from the Kemuk River, 1995.

	<u>1995</u>	Age Group	
		6	TOTAL
n (number)		1	1
Percent		100.0	100.0
Std. Err.			
Mean Length		450	450
Std. Err.			
Sample Size		1	1
Mean Weight		1150	1150
Std. Err.			
Sample Size		1	1

Table 15. Mean lengths (mm) and weights (g) of char from the Kemuk River, 1995.

	<u>1995</u>	TOTAL
Mean Length		507
Std. Err.		11.71
Sample Size		16
Mean Weight		1281
Std. Err.		81.89
Sample Size		16

Table 16. Mean lengths (mm) and weights (g) of Arctic grayling by age group from the Izavieknik River, 1994.

	Age Group	
	4	TOTAL
1994		
n (Known Age)	1	1
Percent	100.0	100.0
Std. Err.		
Mean Length	366	366
Std. Err.		
Sample Size	1	1
Mean Weight	500	500
Std. Err.		
Sample Size	1	1

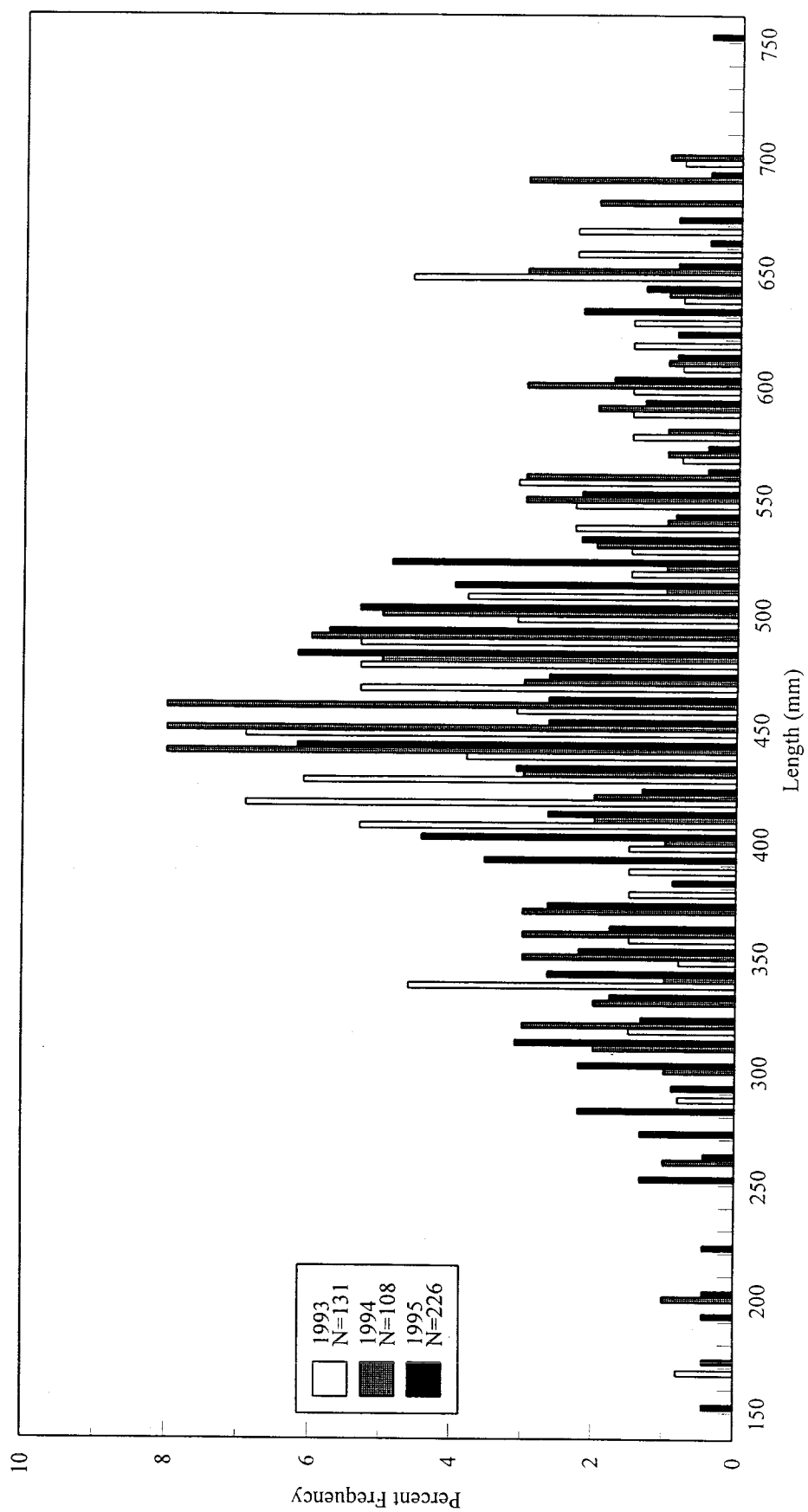


Figure 3. Fork length frequency distribution (10 mm increments) for rainbow trout in Pungokepuk Creek, Togiak National Wildlife Refuge, 1993 - 1995.

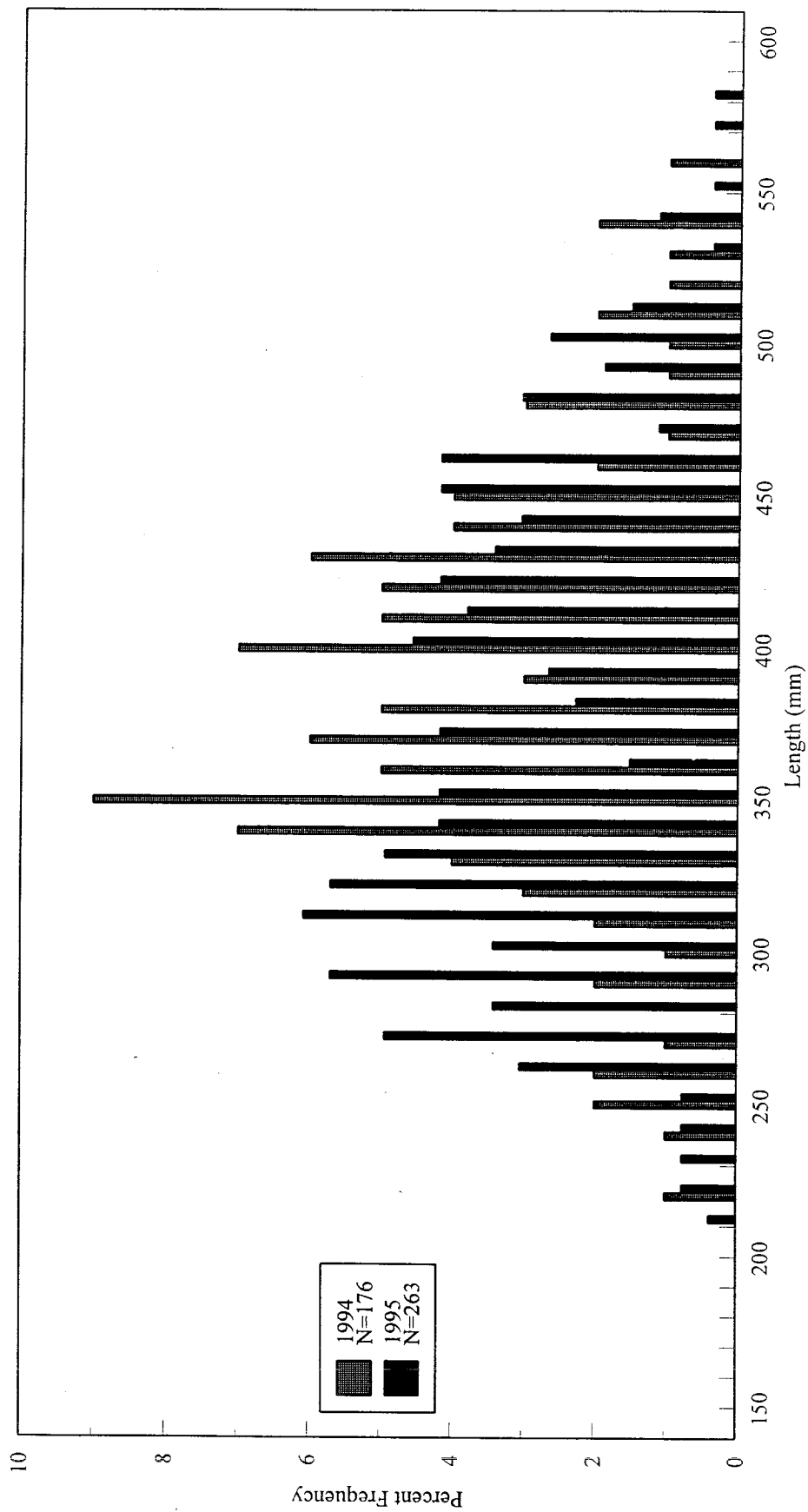


Figure 4. Fork length frequency distribution (10 mm increments) for rainbow trout in Gechiak Creek, Togiak National Wildlife Refuge, 1994 - 1995.

DISCUSSION

Rainbow trout

Rainbow trout are found in the main stem of the Togiak River and in tributaries below Togiak Lake. No records exist of this species being taken from or upstream of Togiak Lake (USFWS 1990). This is supported by the fact that no rainbow trout were caught or sampled on the Izavieknik River located between Togiak Lake and Upper Togiak Lake and that rainbow trout were caught and sampled in the other downstream tributaries surveyed. Sport fish guides reported rainbow trout to be present in the Izavieknik River but none were caught during a 6 day sampling effort in 1994. This may be attributed to sampling timing. Perhaps rainbow trout are in the river at other times for spawning or feeding.

The number of rainbow trout captured from the Ongivinuck ($n=5$) and Kemuk ($n=5$) Rivers was lower than expected. This may be the result of a lack of fish or poor sampling methods. The recapture of a fish originally marked in Pungokepuk Creek indicates that rainbow trout in the Kemuk River may be transient. The catch of rainbow trout also indicates that they are most numerous in the lower half of the Togiak River drainage and may not be normally captured upstream of Pungokepuk Creek.

Rainbow trout sample sizes were highest from Pungokepuk and Gechiak Creeks. Over all years, the range of ages was similar between Pungokepuk Creek (1 to 11 years) and Gechiak Creek (2 to 12 years) rainbow trout. Pungokepuk Creek rainbow trout had a greater maximum fork length than those captured from Gechiak Creek. The authors have observed that the ice free season is shorter for Gechiak Lake and the upper Gechiak River. Although water temperatures were not measured it is likely that Pungokepuk Lake and Creek rainbow trout have warmer, more favorable, growing conditions.

A declining annual mean length and a shift in age distribution to younger age groups is observed between 1993 to 1995 for rainbow trout in both Gechiak Creek and Pungokepuk Creek samples. This shift is likely due to sample size, changes in survey methods or timing, or an actual shift in age structure. Timing of the survey may have the most influence. The larger fish are generally caught early after ice out and just after spawning which makes them normally more accessible. In 1995, most (55%) of the rainbow trout sampled in Pungokepuk Creek were caught during August. The largest rainbow trout caught in Gechiak Creek was caught in May 1993. Sampling was not possible during May in 1994 or 1995 due to ice cover in Gechiak Lake limiting access.

Except for the one rainbow trout recaptured in the Kemuk River there were few rainbow trout observed to have traveled between or within tributary survey sections. Only in Pungokepuk Creek did fish travel between the upper and lower parts of the creek. Three rainbow trout moved from above the gorge to below the gorge. These fish did not travel a long distance between capture events and no fish were observed to have traveled upstream. The gorge is an assumed dividing line of the creek and may be an impassable barrier to upstream migration.

Arctic grayling

Arctic grayling were found in all Togiak River drainage tributaries sampled from 1993 to 1995. Sample sizes in each tributary are small and don't indicate a large grayling population. Whether this is related to environmental conditions, fishing pressure or sampling techniques is not known. Sampling primarily targeted the capture of rainbow trout and likely reduced the grayling catch. Arctic grayling sampled in the Togiak River drainage have a greater maximum length than the grayling sampled in tributaries of the Kuskokwim Bay rivers which ranged from 95 mm to 495 mm (Alt 1977).

Char

Char were caught in each Togiak River tributary and associated lake surveyed between 1993 and 1995. This supports previous known occurrence and distribution of char throughout the drainage (USFWS 1990) and observations made during a survey of tributary lakes conducted from 1987 to 1988 (USFWS, in prep.). Another member of the char family, lake trout *Salvelinus namaycush*, was not captured in the surveyed areas.

Sample sizes of char in each survey area were small and do not allow for comparisons between years or tributaries. All char sampled in each tributary from 1993 to 1995 were similar in size and have a similar range of lengths as the char sampled on the Refuge in 1987 and 1988 (USFWS, in prep.) and to char sampled in tributaries of the Kuskokwim River (Alt 1977). No comparison of length at age can be made between Togiak River drainage char with any other drainage because aging structures were not collected. Scales from char are difficult to use to determine ages and sacrificing the fish to collect otoliths was not a desired objective of this survey.

Northern pike

Northern pike were sampled only in Pungokepuk Creek and Lake during 1993 to 1995. They are reported to occur in several other smaller tributaries and lakes within the Togiak drainage (USFWS 1990), but were not found in the other tributary study areas. However, no sampling occurred in the lower Togiak River drainage where numerous unnamed lakes and ponds occur. During a lake survey project of Refuge lakes in 1987-1988 (USFWS, in prep.), northern pike were sampled only in Pungokepuk and West Togiak Lakes.

Northern pike sampled in Pungokepuk Creek from 1993 to 1995 have a similar range of lengths as the pike sampled in Pungokepuk Lake in 1988 (164 mm to 580 mm) (USFWS, in prep.), and to pike sampled in tributaries of the Kuskokwim River (137 mm to 800 mm) (Alt 1977). No comparison of length at age can be made between Pungokepuk Creek northern pike with any other drainage because aging structures were not collected. Growth and age determinations from

northern pike scales demonstrates that age interpretation is made very difficult as a result of local conditions, rate of growth, circuli number and presence of several types of false circuli (Scott and Crossman 1973).

RECOMMENDATIONS

This study provides the first substantial sample and description of the rainbow trout, Arctic grayling, northern pike and char populations in the Togiak River drainage although sample sizes are small for most species. Recommendations for future work include: (1) continue sampling throughout the drainage to replicate age, weight, and length frequencies for resident species; (2) measure and sample all recaptured fish for age; (3) include secondary marks on tagged fish to allow an estimate of tag loss; (4) marking all future grayling and char samples; (5) measuring total length and fork length of fish, especially rainbow trout, to aid in the assessment of relative stock density categories; (6) use radio telemetry to determine if rainbow trout in tributary streams are discrete stocks; (7) measure all char captured and dissect a proportion to determine species and age; and (8) sampling other tributaries and the main Togiak River. Consistency in sampling methods (angling techniques and effort concentration) and scale age interpretation criteria are critical to establish and maintain between years and between rivers in southwest Alaska.

ACKNOWLEDGMENTS

We thank the Alaska Department of Fish and Game, Sport Fish Division staff in Dillingham and Research and Technical Services in Anchorage, for their assistance in data optical scanning, software and technical assistance. Thanks to the staff of the Togiak National Wildlife Refuge, King Salmon Fishery Resource Office, and the Regional Office for assistance in capture efforts and report editing.

REFERENCES

- ADFG (Alaska Department of Fish and Game). 1990. Instructions for using sport fish creel survey and biological mark-sense forms, 1990. Division of Sport Fish, Research and Technical Services. Anchorage.
- ADFG. 1995, in prep.. The harvest and use of freshwater fish in Togiak and Manokotak, 1994-95. Data management report by the Div. of Subsistence, ADFG, Anchorage and Dillingham, Alaska. For the Bristol Bay Native Assn.
- Alt, K. T. 1977. Inventory and cataloging of sport fish and sport fish waters of western Alaska. Federal Aid in Fish Restoration. ADFG, Division of Sport Fish. Volume 18. Project No. F-9-9.
- Clutter, R. I. and L. E. Whitesel. 1956. Collection and interpretation of sockeye salmon scales. International Pacific Salmon Fishery Commission, Bulletin 9. 159pp.
- Coggins, L.G. 1994. Precision of ages estimated from scales for rainbow trout in Bristol Bay, Alaska. Alaska Department of Fish and Game, Fisheries Data Series No. 94-26.
- Dery, L.M. 1983. Use of laminated plastic to impress fish scales. *Progressive Fish Culture*, 45(2), April 1983. Pages 87-88.
- Heineman, G. M. 1989a. Instructions for using sport fish mark sense diskettes 1989. Alaska Department of Fish and Game, Division of Sport Fish, Research and Technical Services. Anchorage.
- _____. 1989b. BBX2 computer program for analysis of biological samples. Revised 3/13/89. Alaska Department of Fish and Game, Division of Sport Fish, Research and Technical Services. Anchorage.
- Jearld, A. 1983. Age determination. Pages 301-324 in L.A. Nielsen and D.L. Johnson, editors. *Fisheries Techniques*. American Fisheries Society, Bethesda, MD.
- Lux, F.E. undated. Age Determination of Fishes (Revised). U.S. Department of Commerce. NOAA, National Marine Fisheries Service. Fishery Leaflet 637. Revision of Lux, Fred E. Age Determination of Fishes, USFWS, Fishery Leaflet No. 488.
- Howe, Allen L., Gary Fidler, and Michael J. Mills. 1995. Harvest, catch, and participation in Alaska sport fisheries during 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-24, Anchorage.

- Minard, R.E. and D. O. Dunaway. 1995. 1994 area management report for the recreational fisheries of the southwest Alaska sport fish management area. Alaska Department of Fish and Game, Division of Sport Fish. Fishery Management Report No. 95-2.
- Mosher, K.H. 1969. Identification of Pacific salmon and steelhead trout by scale characteristics. USDOI, U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, XF WC-A 317 1-17 (1969).
- Riffe, R. 1994. Pressing Scales. An internal memo describing the performance and procedures of using the hydraulic press for creating acetate scale impressions. Alaska Department of Fish and Game, Dillingham, Alaska. Dated January 14, 1994.
- Scott, W.B. and E.J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada. Bulletin 184.
- Sokal, R.R. and F.J. Rohlf. 1981. Biometry, the principles of statistics in biological research. Second Edition. W. H. Freeman and Company, New York, NY.
- USFWS (United States Fish and Wildlife Service). 1990. Fishery management plan, Togiak National Wildlife Refuge. U.S. Department of the Interior, Fish and Wildlife Service, Alaska.
- USFWS. In preparation. Baseline physical, biological and chemical parameters of 21 lakes, Togiak National Wildlife Refuge, 1984 - 1989. U.S. department of the Interior, Fish and Wildlife Service, Alaska.

Appendix Table 1. Sample size and data filename by year for the Togiak River drainage fishery samples collected and analyzed by USFWS, 1993 - 1995.

Year	Location	Species	Number of Records	Number of Fish Aged	RTS File Number
1993	Pungokepuk Creek	Rainbow Trout	132	111	T1320BA3.DTA
	Pungokepuk Creek	Arctic Grayling	33	33	T1320BB3.DTA
	Pungokepuk Creek	Northern Pike	5	0	T1320BC3.DTA
	Pungokepuk Creek	Char	1	0	T1320BD3.DTA
	Gechiak Creek	Rainbow Trout	9	5	T1400BA3.DTA
1994	Pungokepuk Creek	Rainbow Trout	109	91	T1320BB4.DTA
	Pungokepuk Creek	Arctic Grayling	18	1	T1320BA4.DTA
	Gechiak Creek	Rainbow Trout	177	169	T1400BC4.DTA
	Gechiak Creek	Arctic Grayling	5	5	T1400BB4.DTA
	Ongivinuck River	Arctic Grayling	3	2	T1310BA4.DTA
	Izavieknik River	Arctic Grayling	1	1	T1470BA4.DTA
1995	Pungokepuk Creek	Rainbow Trout	230	195	T1320BB5.DTA
	Pungokepuk Creek	Arctic Grayling	56	55	T1320BC5.DTA
	Pungokepuk Creek	Char	41	0	T1320BD5.DTA
	Pungokepuk Creek	Northern Pike	39	0	T1320BE5.DTA
	Gechiak Creek	Rainbow Trout	263	228	T1400BB5.DTA
	Gechiak Creek	Arctic Grayling	6	6	T1400BC5.DTA
	Gechiak Creek	Char	36	0	T1400BD5.DTA
	Ongivinuck River	Rainbow Trout	5	5	T1310BA5.DTA
	Ongivinuck River	Arctic Grayling	39	39	T1310BB5.DTA
	Ongivinuck River	Char	22	22	T1310BC5.DTA
	Kemuk River	Rainbow Trout	5	4	T1440BA5.DTA
	Kemuk River	Arctic Grayling	1	1	T1440BB5.DTA
	Kemuk River	Char	16	16	T1440BC5.DTA

Appendix Table 2. Distances traveled and hours taken for Togiak River drainage sampling trips.

Togiak River	(km)	Locations
	5.0	Togiak Lake to Kipnuktuli Creek
	20.7	Kipnuktuli Creek to Tshayagagak River
	4.4	Tshayagagak River to Ongivinuak River
	16.8	Ongivinuak River to Kemuk River
	6.6	Kemuk River to Naylorun River
	3.8	Naylorun River to long, unnamed tributary entering on the west side
	1.1	long, unnamed tributary to short, unnamed tributary entering on the west side and originating at small lake
	11.9	short, unnamed tributary to Pungokepuk Creek
	8.7	Pungokepuk Creek to Gechiak Creek
	21.1	Gechiak Creek to Togiak Bay
	100.1	Total length of the Togiak River

Pungokepuk Creek	(km)	Locations
	25.4	Length of creek (lake outlet to Togiak River)
	2.1	Distance to unnamed tributary
	9.1	Distance to Nicholls Creek
	9.8	Distance to gorge

Gechiak Creek	(km)	Locations
	28.3	Length of creek (lake outlet to Togiak River)
	3.8	Distance to first portage
	7.1	Distance to second portage

Ongivinuak River	(km)	Locations
	50.5	Length of river (lake outlet to Togiak River)
	33.6	Distance to No Lake Creek

Kemuk River	(km)	Locations
	46.6	Length of river (lake outlet to Togiak River)
	18.7	Distance to west tributary

Izavieknik River	(km)	Locations
	11.8	Length of river (Upper Togiak Lake to Togiak Lake)
	1.9	Distance to Trail Creek
	7.0	Distance to unnamed tributary

Distance travelled (km)	Approximate time spent (hours)	Day of trip	Location of sampling
1.6	7	First day of sampling	Pungokepuk Lake outlet and downstream
9.1	10	Second day of sampling	Pungokepuk Lake to Nicholls Creek
8.2	12	Third day of sampling	Nicholls Creek to final camp site
8.1	4	Final day of sampling	Final camp site to Togiak River
27*	33		

* Pungokepuk Creek is 25.4km in long. The upper 1.6km are sampled twice - the first night and following day

Distance travelled (km)	Approximate time spent (hours)	Day of trip	Location of sampling
2.3	11	First day of sampling	Gechiak Lake to first camp site
3.7	12	Second day of sampling	First camp site to second camp site
13.7	12	Third day of sampling	Second camp site to final camp site
8.6	3	Final day of sampling	Final camp site to Togiak River
28.3	38		

Distance travelled (km)	Approximate time spent (hours)	Day of trip	Location of sampling
5.4	3	First day of sampling	Ongivinuak Lake to first camp site
23.7	12	Second day of sampling	First camp site to second camp site
21.4	10	Third day of sampling	Second camp site to Togiak River
50.5	25		

Distance travelled (km)	Approximate time spent (hours)	Day of trip	Location of sampling
12.1	NA*		Nenevok Lake to starting point
5.0	NA*	First day of sampling	Starting point to first camp site
11.6	NA*	Second day of sampling	First camp site to second camp site
17.9	NA*	Third day of sampling	Second camp site to Togiak River
46.6	NA*		

* Time spent sampling is not available. The trip was performed as a raptor survey with fish sampling as possible

Distance travelled (km)	Approximate time spent (hours)	Day of trip	Location of sampling
1.9	6	First day of sampling	Upper Togiak Lake to Trail Creek
7.0	8	Second day of sampling	Trail Creek to unnamed tributary
2.9	0.5	Third day of sampling	Unnamed tributary to Togiak Lake
11.8	14.5		

Appendix Table 3. Number of rainbow trout caught, marked and recaptured and number of other species caught and sampled by survey trip per year, Pungokebuk Creek, 1993 to 1995.

1993		RAINBOW TROUT							NUMBER OF OTHER SPECIES CAUGHT AND SAMPLED		
TRIP DATES	CAUGHT	MARKED	NUMBER OF RECAPTURES				TOTAL	ARCTIC GRAYLING	NORTHERN PIKE	CHAR	
			1993	1994	1995						
TRIP #1	17 - 24 MAY	51	38	6	0	0	6	31	5	0	
TRIP #2	26 - 28 JUNE	45	43	1	0	0	1	2	0	1	
TRIP #3	13 - 16 JULY	36	32	3	0	0	3	0	0	0	
TOTAL		132	113	10	0	0	10	33	5	1	

1994		RAINBOW TROUT							NUMBER OF OTHER SPECIES CAUGHT AND SAMPLED		
TRIP DATES	CAUGHT	MARKED	NUMBER OF RECAPTURES				TOTAL	ARCTIC GRAYLING	NORTHERN PIKE	CHAR	
			1993	1994	1995						
TRIP #1	22 - 25 MAY	31	27	0	0	0	0	11	0	0	
TRIP #2	25 - 28 JULY	57	48	3	1	0	4	7	0	0	
TRIP #3	30 AUG - 2 SEP	21	16	1	1	0	2	0	0	0	
TOTAL		109	91	4	2	0	6	18	0	0	

1995		RAINBOW TROUT							NUMBER OF OTHER SPECIES CAUGHT AND SAMPLED		
TRIP DATES	# FISH CAUGHT	# FISH MARKED	NUMBER OF RECAPTURES				TOTAL	ARCTIC GRAYLING	NORTHERN PIKE	CHAR	
			1993	1994	1995						
TRIP #1	15 - 18 MAY	30	27	0	2	1	3	7	0	0	
TRIP #2	9 - 12 JULY	73	62	2	3	0	5	21	12	3	
TRIP #3	22 - 25 AUG	127	93	5	6	6	18*	28	27	38	
TOTAL		230	182	7	11	7	26*	56	39	41	

TOTAL ALL YEARS		RAINBOW TROUT							NUMBER OF OTHER SPECIES CAUGHT AND SAMPLED		
	# FISH CAUGHT	# FISH MARKED	NUMBER OF RECAPTURES				TOTAL	ARCTIC GRAYLING	NORTHERN PIKE	CHAR	
			1993	1994	1995						
	471	386	21	13	7	42*		107	44	42	

* One rainbow trout sampled was a tagloss and was retagged. No data of original tagging date is available.

Appendix Table 4. Number of rainbow trout caught, marked and recaptured and number of other species caught and sampled by survey trip per year, Gechiak Creek, 1993 to 1995.

1993	RAINBOW TROUT							NUMBER OF OTHER SPECIES CAUGHT AND SAMPLED		
	TRIP DATES	# FISH CAUGHT	# FISH MARKED	NUMBER OF RECAPTURES				ARCTIC GRAYLING	NORTHERN PIKE	CHAR
				1993	1994	1995	TOTAL			
	20 MAY	9	7	0	0	0	0	0	0	0
1994	RAINBOW TROUT							NUMBER OF OTHER SPECIES CAUGHT AND SAMPLED		
	TRIP DATES	# FISH CAUGHT	# FISH MARKED	NUMBER OF RECAPTURES				ARCTIC GRAYLING	NORTHERN PIKE	CHAR
				1993	1994	1995	TOTAL			
TRIP #1	22 - 25 JUNE	90	64	0	0	0	0	4	0	0
TRIP #2	30 AUG - 2 SEP	87	75	0	1	0	1	1	0	0
TOTAL		177	139	0	1	0	1	5	0	0
1995	RAINBOW TROUT							NUMBER OF OTHER SPECIES CAUGHT AND SAMPLED		
	TRIP DATES	# FISH CAUGHT	# FISH MARKED	NUMBER OF RECAPTURES				ARCTIC GRAYLING	NORTHERN PIKE	CHAR
				1993	1994	1995	TOTAL			
TRIP #1	23 - 26 JUN	146	134	0	5	0	5	6	0	0
TRIP #2	13 - 16 AUG	117	66	0	0	3	3	0	0	36
TOTAL		263	200	0	5	3	8	6	0	36
TOTAL ALL YEARS	RAINBOW TROUT							NUMBER OF OTHER SPECIES CAUGHT AND SAMPLED		
	TRIP DATES	# FISH CAUGHT	# FISH MARKED	NUMBER OF RECAPTURES				ARCTIC GRAYLING	NORTHERN PIKE	CHAR
				1992	1993	1994	TOTAL			
		449	346	0	6	3	9	11	0	36

Appendix Table 5. Number of rainbow trout caught, marked and recaptured and number of other species caught and sampled by survey trip per year, Ongivinuck River, 1995.

1994	RAINBOW TROUT							NUMBER OF OTHER SPECIES CAUGHT AND SAMPLED		
	TRIP DATES	# FISH CAUGHT	# FISH MARKED	NUMBER OF RECAPTURES				ARCTIC GRAYLING	NORTHERN PIKE	CHAR
				1993	1994	1995	TOTAL			
	25 JULY	0	0	0	0	0	0	3	0	0
1995	RAINBOW TROUT							NUMBER OF OTHER SPECIES CAUGHT AND SAMPLED		
	TRIP DATES	# FISH CAUGHT	# FISH MARKED	NUMBER OF RECAPTURES				ARCTIC GRAYLING	NORTHERN PIKE	CHAR
				1993	1994	1995	TOTAL			
	28 JUNE - 1 JULY	5	5	0	0	0	0	39	0	22
TOTAL ALL YEARS	RAINBOW TROUT							NUMBER OF OTHER SPECIES CAUGHT AND SAMPLED		
	TRIP DATES	# FISH CAUGHT	# FISH MARKED	NUMBER OF RECAPTURES				ARCTIC GRAYLING	NORTHERN PIKE	CHAR
				1992	1993	1994	TOTAL			
		5	5	0	0	0	0	42	0	22

Appendix Table 6. Number of rainbow trout caught, marked and recaptured and number of other species caught and sampled by survey trip per year, Kemuk River, 1995.

1995	RAINBOW TROUT							NUMBER OF OTHER SPECIES CAUGHT AND SAMPLED		
	TRIP DATES	# FISH CAUGHT	# FISH MARKED	NUMBER OF RECAPTURES				ARCTIC GRAYLING	NORTHERN PIKE	CHAR
				1993	1994	1995	TOTAL			
	12 - 15 JULY	5	4	0	0	1*	1	1	0	16

* This recaptured rainbow trout was originally sampled on 17 May 1995 in Pungokepuk Creek and was recaptured on 14 July 1995 in the Kemuk River.

Appendix Table 7. Number of rainbow trout caught, marked and recaptured and number of other species caught and sampled by survey trip per year, Izavieknik River, 1994.

1994	RAINBOW TROUT							NUMBER OF OTHER SPECIES CAUGHT AND SAMPLED		
	TRIP DATES	# FISH CAUGHT	# FISH MARKED	NUMBER OF RECAPTURES				ARCTIC GRAYLING	NORTHERN PIKE	CHAR
				1993	1994	1995	TOTAL			
	10 - 15 AUGUST	0	0	0	0	0	0	1	0	498

